

RoboRoach Surgery Instructions

Materials: In addition to the RoboRoach Kit you will need:

- Pair of fine forceps (tweezers). A good one costs about \$10 at the drug store.
- Magnifying glass with its own stand. You can get this at RadioShack or Fry's for ~\$5-15.
- Low-temp hot glue gun, which you can buy at a drug store or arts and crafts store. - \$5.
- Some wooden Q-tips or similar – trivial.
- Small piece of ~120 grit sandpaper –trivial.
- Loctite control gel super glue ~\$4 at a grocery store or hardware store.
- Toothpick (wood splint).
- Ice Water Cup.
- Silly putty.
- Small syringe needle.
- Small amount baking soda or flour.
- Dissection scissors.
- A large healthy adult Discoid cockroach.

*IMPORTANT: Adults have wings and will no longer molt. Therefore, affixing a connector to its head permanently is fine. NOTE: if you glue an electrode connector to a juvenile cockroach (no wings), it will not be able to split its exoskeleton when molting and will die. Do not do this surgery on juvenile cockroaches.



Step I: Attaching the connector to the roach:

1. Take a large healthy adult Discoid cockroach and place it in ice water to anesthetize it (2-5 minutes- until it stops moving).
2. Once anesthetized, remove from ice water with forceps and place the cockroach on your table. With sandpaper, lightly sand the pronotum to remove the waxy covering. Once the pronotum feel “lightly rough” to the touch, enough of the cockroach waxy covering has been removed to allow the connector to glue to pronotum.



3. Using superglue, glue electrode connector to pronotum, with electrodes pointing in an anterior direction (towards antenna). (Put the glue on the pronotum and use forceps to place the connector on top of the glue). The connection should be strong enough in 1-2 minutes. Don't touch the super glue with your fingers because it will stick to you!



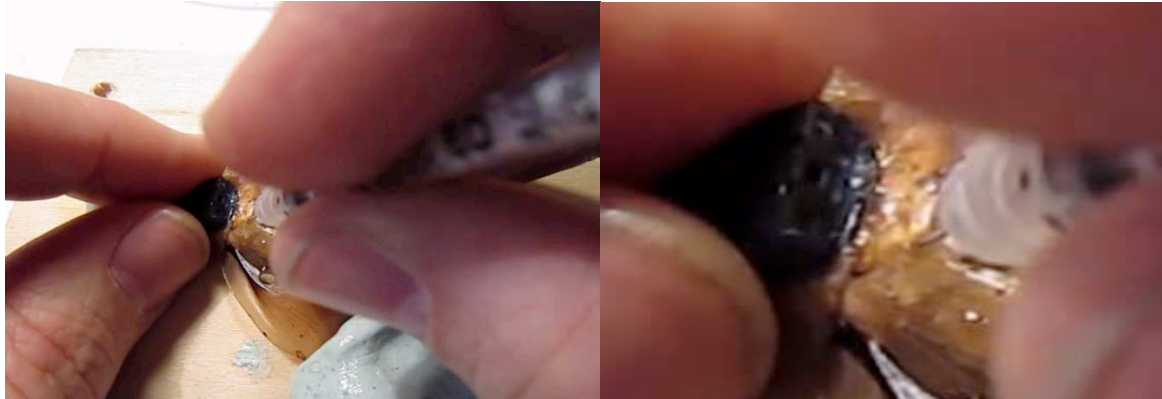
Step II: Inserting ground wire in Thorax (Hardest part):

4. Place cockroach back in ice water for 1-2 minutes.

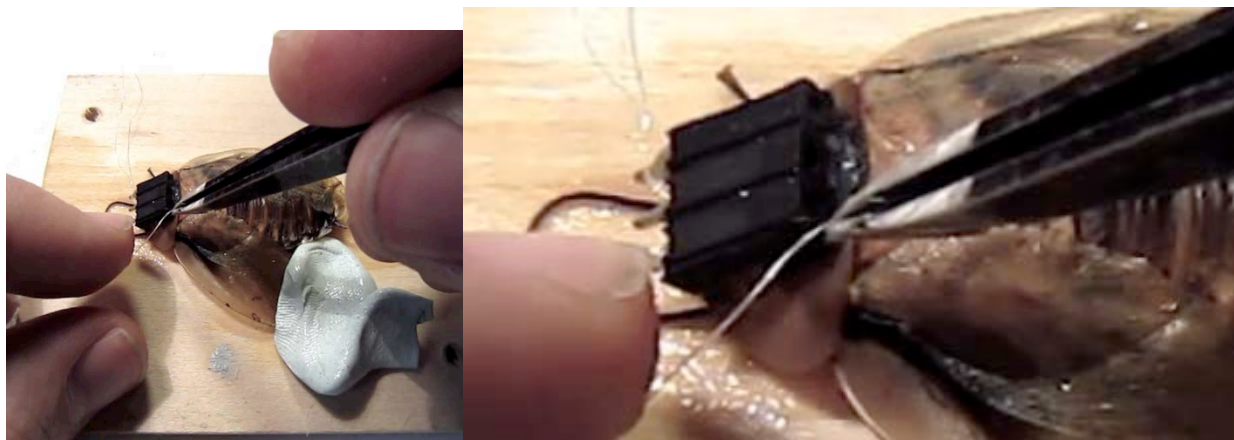
5. Take cockroach out of water, and carefully splay one wing to the side. Use silly putty to hold wing down. Use q-tip to dry thorax and lightly sand (because this is a glue step) the thorax. Again, remove any excess water using the q-tip to dry the thorax.



6. Take a small syringe needle, and lightly poke a small hole on a side of the cockroach just behind the head (exoskeleton of thorax). Avoid the center line as that is where the esophagus is. The flight muscles on the sides can tolerate a small poke.



7. ****May want to use magnifying glass for this step**** Take the left-most electrode wire (from the cockroach viewpoint) and, carefully with a pair of forceps, “park” the electrode 1 mm into the hole (this is hard- wire may crumble on itself and may take multiple attempts to get park the wire)



8. Use a splinter of wood to put a small bead of superglue on electrode just above where it begins to enter tissue (where it is “parked”).



9. Use forceps to carefully insert electrode further into body until superglue just enters wound (~1-3mm below surface, so it is in contact with the saline of the body). Add a little more superglue on top of where you just inserted the wire. The glue will polymerize immediately. Test strength with a light tug. Beware that the small silver electrodes are very fragile though.

10. Bring Wing back over ground electrode (remove silly putty and put wing back in normal position).

11. Place Cockroach back in ice water for 1-2 minutes.

Step III: inserting antenna electrodes:

12. Take the cockroach out of the ice water, turn it on its back, and use forceps to splay the antenna out and cut the cockroach left antennae to ~5 mm (~1/8 – 1/4 inch). Taking the middle electrode, “park” the electrode 1 mm inside the antenna (not all the way in).



13. Like you did earlier, dab a bead of superglue just above where the electrode is in the antenna (parked), and then use forceps to insert the electrode such that the superglue bead goes just into the antenna (~2-4mm into the antenna) and add a bit more super glue at the top after the wire is inserted. Similar to the ground wire placed in the back, the superglue should polymerize immediately. The point is to get superglue just inside the inner ring of the antenna; otherwise it will fall out easily. Don't touch glue with fingers because it will stick to you!

14. Place the cockroach back in ice water for 1-2 minutes

15. Repeat steps 12 -14 for the remaining electrode and right antenna.

Almost done!

Step IV: Reducing slack

16. It is important that the “wire slack” be cleaned up. Using your forceps, carefully organize (fold back) the wire slack on top of the connector. Try to ensure as little slack wire exists between antenna and connector. Cockroach legs are very strong and can pull electrodes out if they get a firm hold. Also ensure “exposed” parts of silver wire are not touching.

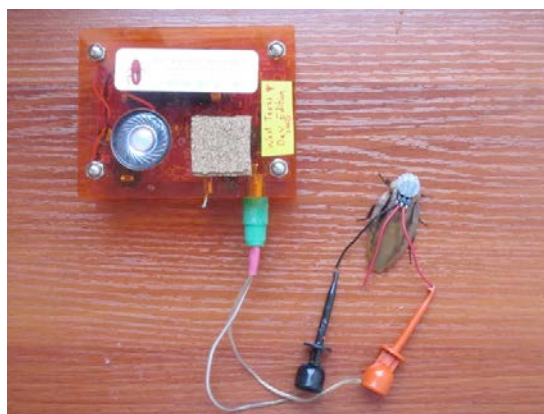


17. To hold excess wire in place, use a hot glue gun and place a dab of hot glue on top of the wires.

18. Take a flat edge, like a small ruler and the end of your forceps, and coat it with flour or baking soda. Take your flat edge and smush down hot glue. The purpose of the flour is to prevent the hot glue from sticking to your tool.



19. The surgery is done! Now test for neural activity. You can use the included “leesh” to test for units between the ground wire and antenna. You should hear nice spontaneous activity. Note: sometimes the spikes are so high amplitude it clips out the speaker on the SpikerBox and you won’t hear anything. Plug in an external speaker or headphones to hear your spikes. You can also do some experiments with this prep. Blowing on the roach causes broad neural activation.



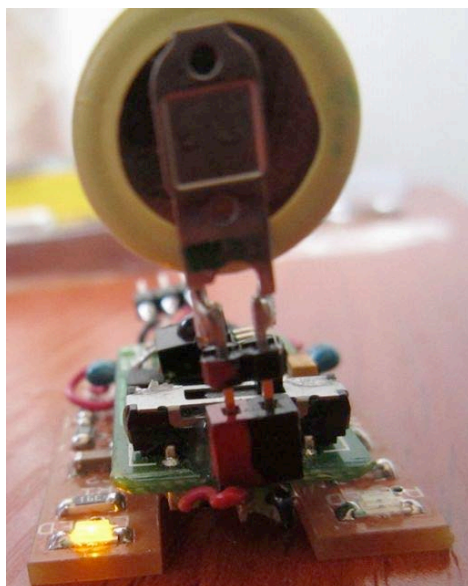
20. If you hear spikes, your surgery was successful (make sure to try both sides). You can return the cockroach to its home terrarium to recover and wait a few hours before doing your experiment.

Testing the RoboRoach

1. Insert your battery into the back of the RoboRoach circuit so that the red side of the battery lines up to the red side on the connector.
2. Make sure the “switch” on the RoboRoach Circuit is all the way to the right (cockroach right), and the toggle on the remote control is on the “B” channel.



3. Pointing the remote control at the RoboRoach circuit, you should see the left and right LED light up when you press the L or R button on the remote control. If it doesn't, your battery is dead in either the circuit or the remote control.

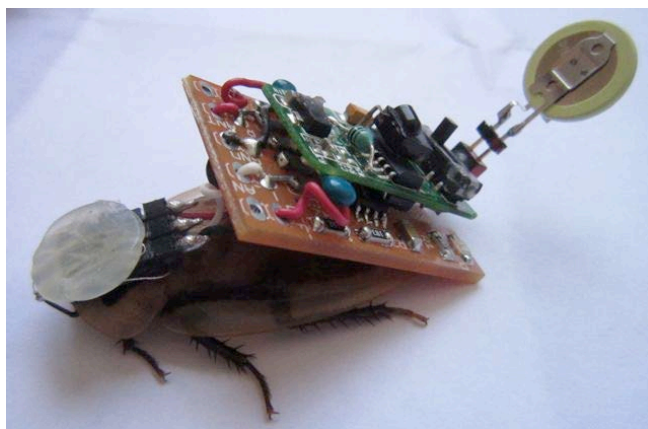


4. Take your RoboRoach out of its terrarium. You may find cooling down the RoboRoach in the fridge for a couple minutes may make the circuit easier to plug in. It depends on the cockroach. Plug the male connector of the circuit into the female connector on the roach's head.

5. Using your hot glue, place a dab on the underside of the circuit and attach it to the back of cockroach. Try your best to balance the circuit. The Circuit is on the heavy side (we are working on it), but the cockroach can carry it for a few minutes for your demo.

6. If you have cooled the cockroach, wait about 5 minutes for it to warm up.

7. Toggle the switch on the circuit from left to right (ending in right position) to ensure RoboRoach circuit is on (it will auto turn off after about ~5 minutes of inactivity).



8. Place the RoboRoach on the ground. Lightly tap the rear of the RoboRoach with a tooth pick. When he starts running, stimulate the antenna with your remote control. For a couple minutes, you can make the cockroach turn left or right (opposite side of stimulation). You will find he adapts very quickly. You can use this adaptation effect to talk about learning to your students.

9. After your experiment, carefully unplug the circuit from the RoboRoach, and lightly peel the circuit off the wing. The glue does not stick very well (a good thing!) and should peel off the waxy wing with care.

10. Clean hot glue off RoboRoach circuit, remove battery, and return cockroach to its home. Note: Do not leave the battery in the circuit! Remove immediately after use, as you only have about ½ hour of operation per battery, and there is a slow quiescent drain when the battery is plugged into the RoboRoach circuit but not being used.

11. After a couple days, cut the antenna wires. Your RoboRoach will be healthier. Its natural behavior is to wave its antenna around, and it will get stressed over time when it can't do this. We've found vitality is higher if you cut the antenna wires. You can now retire your RoboRoach from active duty status and allow it to spend the rest of its cockroach life eating organic lettuce, playing in toilet paper rolls and work scraps, and raising a family.

Note for Demo's:

When I am doing afternoon demo's, I do the surgery in the morning. When I am doing morning

demo's I do the surgery the night before.

Failure Modes:

The back ground wire will fail (break), normally within 1-2 days. The stimulation will stop working after ~5 days anyway if back wire does not fail, perhaps due to scarring around the antenna electrodes. Back wire failure is principal flaw in surgery and design. NOTE: We have recently discovered that twisted three wires together for the ground wire makes the connection much stronger, and if you order a RoboRoach in early March 2012, we began shipping RoboElectrodes with the improved ground wire.